succession of ages that have since elapsed, erosion has been continuously in progress, and the result is the scenery of the Cañon region. Capt. Dutton gives what appear to be good reasons for believing that the larger rivers flow along the same channels which they took at the beginning, but that the minor tributaries, where any exist (and they are conspicuously absent in some wide districts), are comparatively recent in origin, and have been determined by modern surface conditions. The excavation of the Grand Cañon of the Colorado has thus been going on ever since the Eocene period. During that enormous interval the climate of the region appears to have passed through successive oscillations. There is no more skilful feature of the volume before us than the way in which the scattered facts that bear on this question are marshalled to their places and made to tell their story. Ancient river-beds, which for ages have been dry and are partly filled up with debris, open on the edge of the great chasm. They doubtless discharged their waters into the main river at a time when rains were abundant and watercourses numerous. But their fountains have long since been dried up, and their fading channels are almost gone. But all the while the Colorado and its larger feeders, drawing their supplies from far well-watered uplands, have continued their task of erosion until they have sunk their channels in some places more than a mile below the level of the plateau across which they flow.

The process of the excavation of the Grand Cañon is treated at length, and much new information is given as to its varying conditions. The details of the erosion are described with great clearness. The two final chapters, wherein these subjects are discussed, contain much that is suggestive, and deserve careful perusal by all who take interest in questions of denudation. They are condensed pieces of reasoning which cannot be intelligibly summarised here, and which indeed one is hardly prepared to find in an official report. Like his colleague, Mr. G. K. Gilbert, Capt. Dutton properly lays great stress upon the influence of an arid climate as one of the chief factors in cañon excavation. He points out how the absence of vegetation exposes the surface of bare rock to the action of rain. But it may be doubted if the scanty rains of the region can do more than remove material already disintegrated. We have to account for the continuous lowering of the level of the plateaux, and the removal of so vast a depth of stratified rock from their surface. Capt. Dutton himself admits that most of the rain which falls upon the country is absorbed by the rocks, and gushes out in copious springs at the base of the cañon-walls, thereby notably increasing the volume of the river. But there is everywhere a perceptible disintegration of the rock at the surface. This decay cannot be attributed to frost, which in so dry a climate can have but small effect. It seems to be due in large measure to the superficial strain induced by a great daily range of temperature. And it is no doubt aided by the action of wind, which removes the loosened particles, and exposes a new surface to the same kind of disintegration.

In conclusion, reference must be made to the truly magnificent series of illustrations by which this monograph is accompanied. The maps of the atlas give the reader a clear mental picture of the general topography and geological structure of the region. But it is by the pictorial illustrations that he will be chiefly fascinated. These are scattered profusely through the text, and form an important feature in the atlas. Mr. Holmes, whose reputation for the accurate and artistic rendering of geological details is so well established, has here far surpassed all his previous efforts, and has produced the most impressive and instructive geological pictures that have ever been made. His large coloured views of the Grand Cañon are in themselves a series of lessons in geology far more interesting and effective than can be supplied in words. The United States may be heartily congratulated on this first of the monographs of their Geological Survey. Let us hope that Congress will continue in the same liberal spirit the annual appropriations that have enabled the Director of the Survey and his associates to produce such splendid results. ARCH. GEIKIE

CENTRAL ASIA

Travels and Adventures East of the Caspian during the Years 1879-81, *including Five Months' Residence among the Tekkés of Merv.* By Edmond O'Donovan. Two Vols. (London : Smith Elder, 1882.)

Wanderings in Baluchistan. By Major-General Sir C. M. MacGregor, K.C.B. (London : Allen and Co., 1882.)

MR. O'DONOVAN'S venturesome excursion to the Merv Oasis stands out conspicuously as perhaps the most romantic episode in the recent annals of Central Asiatic travel. Yet in proceeding eastwards his original goal was not the Mervli Turkomans, but their western kindred, the Akhal Tekkés of the Daman-i-Koh. Sent out as the Special Correspondent of the *Daily News* with the Russian expedition against those nomads in 1879, he was at first well received, and spent some profitable time during the progress of military operations on the Caspian seaboard. But after the death of General Lazareff, having been suddenly banished from Chikislar, his ramblings lay henceforth mainly within the North Persian frontier. Here he again went over the ground, with which we have been made tolerably familiar by V. Baker, Macgregor, Stewart, and other recent explorers. Nevertheless even of this region Mr. O'Donovan has much to tell us, which is both new and interesting. There is a freshness and a fulness of detail in his account of Meshed, Tehrán, Kuchan, Resht, Shahrúd, as well as of the people and scenery of Khorasán and Mazandarán, which lend a peculiar charm to the first of these brilliantly written volumes.

But the chief interest of the work naturally centres in the section devoted to the Merv Oasis and its Tekke Turkoman inhabitants, with whom the traveller passed a forced residence for over five months during the year 1881. How he eluded his Persian escort, crossed the border above Sarakhs, traversed the Tejend river valley, plunged boldly into the heart of the desert, safely reached the Murghab Oasis, allayed the suspicions of the Tekkés, who took him for a Russian spy, gradually gained their confidence, became in fact a "Tekke of the Tekkés" and head of a Turkoman triumvirate, finally, by a rare combination of tact, patience, and courage, again escaping from his too importunate friends, all reads far more like a wild piece of fiction than so much sober history.

Although Colonel Stewart had recently brought home some accurate information regarding the present state of the Oasis, this region had been actually visited by no European traveller since Abbot's expedition in 1840. Hence Mr. O'Donovan is here on comparatively new ground, and his graphic account of the place and its inhabitants will be read with deep interest, especially by those who have not seen the portions already published in the *Daily News*. Since the Russian occupation of the Akhal country, the Oasis has doubtless lost whatever strategical significance it may have hitherto possessed. Nevertheless its position in the desert midway between the Oasis and Caspian, its great fertility and dense population—estimated at about 500,000--its numerous antiquities and grand historic memories, must always ensure for the "Queen of the World" an exceptional importance in the eye of the statesman and historian. The student will here find ample details of its present social and economic condition, of its government and administration, of the organisation of the Toktamish and Otamish Tekke tribes,[1] their local institutions, the water system of the Murgháb, the remains of Bairam Ali, and other cities which successively bore the name of Merv, the home life of the Mervlis, their actual commercial and political relations and future prospects.

A very full description is given of the many ruins scattered over the Oasis, all of which were visited and sketched by the explorer. Of these the most extensive are Giaur Kala, the original site of Merv, destroyed about the end of the seventh century by the Arabs, and Bairam Ali, its successor, destroyed in 1784 by the Amir of Bokhara. A general plan is given of all these crumbling citadels, palaces, tombs, baths, and earthworks, "where now no living creature is to be met with, save an occasional Ersari robber or treasure seeker. For here, as in almost every other part of the East, the popular imagination enriches these ruined vaults and foundations with secret treasures stowed away beneath them" (ii. 241).

From the frequent recurrence of the term *Kalassi*, supposed to be a corruption of *ecclesia*, some archæologists have scattered the remains of ancient Christian churches with a liberal hand over Western Turkestan. But Mr. O'Donovan suggests that there is here a confusion between *Killissi*, which really represents *ecclesia*, and *Kalassi*, a Turki form of the Arabic *Kal'a*, a fort or castle.[2] Hence Kara Kalassi, for instance, would mean, not the "Black Church," but the "Black Castle." In Armenia, a Christian country, *Killissi* certainly occurs; but in the Oasis Mr. O'Donovan "never came upon any structure which could possibly have been a Christian Church" (ii. 177).

Amongst the remains are some earthworks bearing the title of Iskander Kala, or "Alexander's Castle," the local tradition being that the Macedonian army encamped here on its way to India. But here again he pertinently remarks that "in these countries Alexander comes into every story connected with ruins of remote antiquity."

Some points of resemblance are discovered between the Turkoman and Kelt, which are probably not intended to be taken seriously. But the description of the Turkoman type, coming from a shrewd and original observer, possesses sufficient ethnological value to deserve quoting:

> "The usual Turkoman physical type, both male and female, is rough, rude, and vigorous, and quite in contrast with that of the frontier Persian, which is sleek, cat-like, feeble, and mean. The worst part of the Turkoman is his head, which is decidedly conical, the point being thrown somewhat to the rear. A phrenologist would say that firmness was very pronounced, conscientiousness wanting, and benevolence small. The features are not of that Tartar cast that one would be apt to suppose in denizens of East Caspian districts, and though here and there may be seen a suspicion of peeping eye, a tendency towards flattening of the point of the noise, and occasionally high cheek bones, on the whole the faces are more European than otherwise. In fact I have seen some physiognomies at Gumush Tepé which, if accompanied by an orthodox European dress, would pass muster anywhere as belonging to natives of the West. It is among the women that the absence of European features is most conspicuous. There are many of them who could fairly be reckoned pretty, though it is quite a different order of beauty from that to which we are accustomed. . . . It is among the men that the handsome individuals must be sought for, especially when there has been an admixture of Persian blood. The scanty beard of the pure Turkoman is then replaced by one of much more luxurious proportions, and of a darker tint; the nose assumes a more or less aquiline form, and the eye loses the cold grey expression so characteristic of the pure-blooded dweller on the Steppes" (i. 231-3).

The accompanying portrait of the author in oriental garb might be taken as an apt illustration of this description. There is also an excellent map of North Persia and the Trans-Caspian region, based on that of Colonel Stewart, but with numerous fresh details embodying the results of the explorer's observations in the Tejend Valley and Merv Oasis. But the spelling is as usual at variance with that of the text, and there is unfortunately no index. The appendix contains facsimiles of a number of letters from Turkoman Khans, one or two of which are fine specimens of the beautiful ta'lík penmanship.

The reputation of an intelligent and enterprising explorer secured to General Macgregor by his "Journey through Khorasán (noticed in NATURE, vol. xx. p. 453) will be considerably increased by his "Wanderings through Baluchistan." The trip was made in company with the ill-fated Capt. R. B. Lockwood, of the 3rd Bengal Cavalry, on their return to duty in India, between the months of September, 1876, and March, 1877. During this period the western section of Makrán was thoroughly explored, and the problems connected with the drainage of the Mashkíd and Mashkel rivers at last cleared up. The Mashkíd was supposed by many geographers to flow through the Dasht to the Arabian Sea, while the Mashkel was sent northwards to the Zirreh or Sistán Hamun, that is, to the Helmand basin. But by actual survey the explorers have shown that (1) both of these rivers belong to the same hydrographic system; (2) this system is unconnected either with the Helmand or Arabian Sea; (3) the two streams, after their confluence above the romantic Tank Zorati pass in the Sianeh-kuh range, flow mainly north-west to the Mashkel Hamun in 28° 20′ N., 60° E.; (4) this swamp has no outlet, and is actually separated by another depression, the Kindi Hamun, and by a range of hills, the Koh-Amir, from the Sistán Hamun. A ride performed under great difficulties across the Kharan desert to the neighbourhood of the Sistán swamp placed all these points beyond doubt, so that the drainage system of the hitherto almost unknown region along the Perso-Baluch frontier, from the Lower Helmand to the Arabian Sea, has now been satisfactorily determined. From Sistán the travellers made their way by two new and parallel routes right across North Baluchistan to Jacobabad in Sind. The numerous typographical points recorded both here and throughout West Makrán are embodied in the accompanying map, which is on a large scale, and which forms an important contribution to our knowledge of the south-eastern section of the Iranian plateau. In the appendix are given the directions, distances, and other useful details of no less than twenty-two routes in the same region. The relief of the land and its salient physical features are also further illustrated by numerous sketches made on the spot by General Macgregor. Much valuable matter regarding the Baluchi and Brahui tribes, and the present political situation of Baluchistan, is scattered over the pages of this pleasantly written volume.

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[1] The subdivisions of these two main branches of the Merv Tekkés do not correspond with those given by Mr. Marvin in his "Merv, the Queen of the World." Some of the discrepancies however may be reconciled by restoring to their proper form the names disguised in Mr. O'Donovan's peculiar orthographic system. Thus his *Karatchmet* appears by reference to Marvin's tables to stand for the *Kara-Ahmed* subdivision of the Otamish branch.

[2] At the same time this *Kalassi* would appear in many cases to be simply the Persian *Kalása*, a well, and especially the watering-places maintained at intervals in the desert for the convenience of caravans and pilgrims to Mecca.

A. H. KEANE

PHYSICAL OPTICS

Physical Optics. By R. T. Glazebrook, M.A., F.R.S. (London: Longmans, 1883.)

THIS is the most recent volume of the well-known series of Text-books of Science published by Messrs. Longman. Mr. Glazebrook is already favourably known as an accurate experimenter and an able theorist in the subject of which this volume treats, and it is therefore unnecessary to say that the treatise under notice contains a large amount of authentic and interesting information on all branches of the subject. We must confess, however, to a certain feeling of disappointment after going through the book, arising chiefly from the fact that the author does not appear clearly to have made up his mind as to the class of readers to whom the book is to be useful. Those who have had any experience in real personal teaching of the artisans and students in science schools for whom the volumes of this series are stated to be intended, will soon perceive that Mr. Glazebrook has assumed an amount of mathematical knowledge and ability which very few of them possess. On the other hand results are occasionally assumed, the investigation of which would be quite within the reach of those university students who will probably form the larger part of the readers of the treatise. For instance, the investigation of the focal lines of a pencil refracted in a principal plane through a prism, and the condition of their coincidence in the position of minimum deviation, is settled by an "it may be shown," although the analysis required is certainly not more difficult than much that is given in the book, and the point to be elucidated is of considerable importance.

The author has intentionally introduced a large quantity of matter which is usually considered to belong to the kindred subject of Geometrical Optics, and although there will probably be a difference of opinion as to the advantage of this proceeding, there will be none as to the clearness of the explanations and the excellence of the diagrams employed. There does not seem to be quite so much "matter new to the text-books" as is hinted at in the preface, but on the whole the book furnishes a good account of the subject, comparable with Lloyd's well-known treatise on the Wave Theory of Light, and dealing with many points which have been investigated since the date of the latter work.

Where there is so much of good, it is a pity that it should not be made better, and there are a few points in which perfection has not been reached. In places there is a tendency to a slipshod and "high-falutin" method of expression which may be forgiven in University Extension lectures delivered extempore to popular audiences, but which is hardly suitable for a scientific treatise. On p. 2 we have a graphic representation of the author raising his arm and of the effect thereby produced on his own body. Later on in the book, quitting the solitary first person, he becomes more friendly to his readers, and speaks of "our apertures, our lens, our prism, our eye," and so on. He even presently hands the apparatus entirely over to the reader and directs him to perform the operations for himself. A more serious matter is the want of care in revising the proofs. For instance, on p. 202 an effect is spoken of as "that due to a single aperture multiplied by a number of apertures," which is nonsense, the author's meaning being "multiplied by *the* number of the apertures.'' Again, on p. 141, the sentence—"They are distinct from the coloured rings of thick plates discovered by Newton, and were described by him as follows," gives an almost opposite meaning to that which the author intended. It ought to read "which were described."

The proper names are not treated with the accuracy and uniformity which are desirable. We have Fraunhofer usually, but on p. 316 Frauonhofer. Huygens appears on p. 15, but more frequently the name is met with as Huyghens, while the possessive case assumes the different forms of Huyghen's, Huyghens', and on p. 226 Huyghens's. Defects of this kind mar the pleasure with which the book would otherwise be read, and seem to indicate that more care might have been advantageously bestowed on the original composition as well as on the revision of the proofs. Possibly the author wishes to leave something to be looked for in the second edition, for the speedy arrival of which he has our best wishes.

OUR BOOK SHELF

The Year-Book of Pharmacy, 1882. 8vo. Pp. 607. (London: Churchill, 1883.)

THIS volume contains a number of exceedingly interesting papers and extracts. The most interesting are those which relate to the artificial production of organic alkaloids, for when we obtain such a knowledge of the constitution of these bodies as will enable us to make them artificially, we may hope that a new era will commence in medicine, and that the results of the treatment of disease will be more definite and satisfactory than heretofore.

Prof. Ladenburg, who has been engaged for some time on researches into those alkaloids which dilate the pupil, is still continuing his researches, and has obtained very interesting results indeed. Atropia when heated with strong hydrochloric acid splits up into a base, tropine, and an acid, tropic acid. While pursuing his investigations upon tropine, the author came to the conclusion that this base contained an alcoholic hydroxyl group